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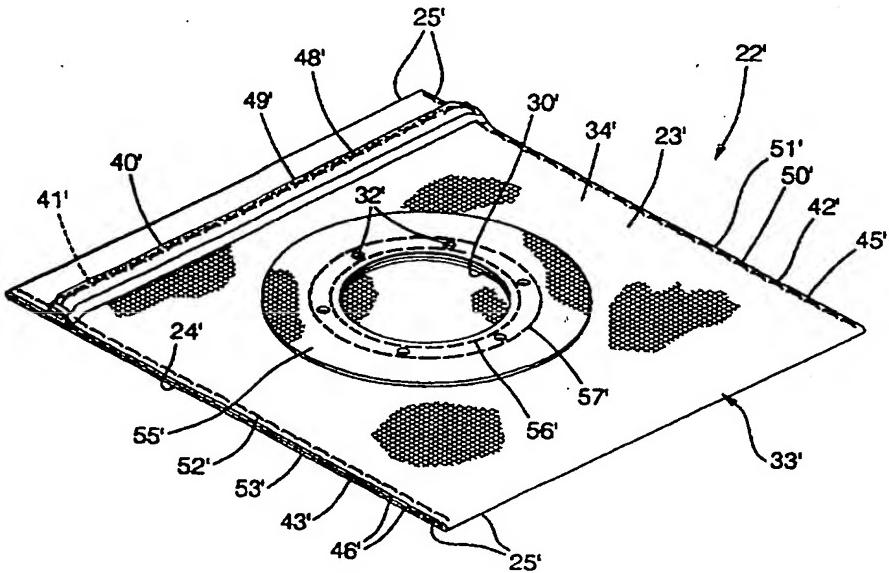
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(54) Title: INFLATABLE RESTRAINT CUSHION



(57) Abstract

An inflatable restraint cushion (22') includes a single longitudinally elongated strip (33') of material folded onto itself and having overlying outer mating edges (40', 41', 42', 43') connected together to provide a generally rectangular-shaped cushion. Preferably, the strip (33') is one continuous piece of material and is generally rectangular. Also preferably, the strip (33') includes a cushion opening (30') for receiving inflator gas.

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INFLATABLE RESTRAINT CUSHION

TECHNICAL FIELD

This invention relates to an inflatable restraint cushion for
5 use in a vehicle.

BACKGROUND OF THE INVENTION

It is well known in motor vehicles to provide a supplemental
inflatable restraint system for protection of a vehicle occupant. The
restraint system includes an inflatable restraint cushion which is rapidly
10 inflated by discharging gas from an inflator when the vehicle experiences
certain predetermined conditions.

Restraint cushions are typically comprised of two or more
fabric panels sewn together along mating edges. For example, the prior
art discloses a typical driver's side restraint cushion including two round
15 fabric panels sewn together at the circumferential mating edges. These
restraint cushions require a heavy fabric with a high denier to withstand
the stress placed on the seams of the cushion during inflation.

SUMMARY OF THE INVENTION

An inflatable restraint cushion in accordance with the
20 present invention is characterized by the features specified in claim 1. The
cushion preferably has a generally rectangular shape which reduces
stresses on the cushion during inflation. Also advantageously, the seams
of the cushion are preferably placed such that they are subject to lower
stress during inflation. The cushion is preferably formed from a single
25 elongated strip of material and is easy to construct due to the location of
the seams. Another advantage is that higher material utilization is
preferably achieved since the cushion is formed from a single elongated
strip of material, as opposed to odd-shaped or multiple pieces of material
used in prior art cushions.

These advantages are accomplished in a preferred form by preferably providing a restraint cushion including a single longitudinally elongated strip of material folded onto itself and having overlying outer mating edges connected together to provide a generally rectangular-shaped cushion. Preferably, the strip is one continuous piece of material and is generally rectangular. Also preferably, the strip includes a cushion opening for receiving inflator gas.

Preferably, a method of making a generally rectangular restraint cushion includes providing a single longitudinally elongated strip of flexible material; folding the material onto itself to provide overlying outer mating edges; and connecting the overlying mating edges together. A cushion opening is preferably provided in the strip and the restraint cushion is turned inside out through the cushion opening.

In another preferred form, a method of making an inflatable restraint cushion includes providing a single longitudinally elongated strip of material having first and second opposing lateral edges; folding the material in half such that the lateral edges are matingly aligned atop each other; connecting the lateral edges together to provide a continuous loop having opposing overlying longitudinal edges; and connecting the respective overlying longitudinal edges to provide the generally rectangular-shaped restraint cushion.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention is described below, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a vehicle interior showing a driver's side restraint cushion in an inflated condition;

Figures 2A - 2F are perspective views showing the steps for assembling the restraint cushion; and

Figures 3A - 3D are perspective views showing the steps for assembling an alternate embodiment of the restraint cushion.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Referring to Figure 1, a vehicle interior 10 includes a driver's side seat 11 and a passenger's side seat 12. A driver's side occupant 14 is seated in the driver's side seat 11 and a passenger's side occupant 15 is seated in the passenger's side seat 12. An instrument panel 16 extends across the interior 10 forward of the occupants 14, 15. A steering wheel 17 is located forward of the driver's side occupant 14 and includes a supplemental inflatable restraint system 20 mounted thereon.

An inflatable restraint cushion 22 of the restraint system 20 is shown in the deployed condition in Figure 1. The cushion 22 has a generally rectangular shape and includes a forward wall 23, an opposite rearward wall 24, and four side edges 25 interconnecting the forward and rearward walls 23, 24. The rearward wall 24 of the cushion 22 opposes the driver's side occupant 14 for restraint when the cushion 22 is in the inflated condition as shown in Figure 1. Although the cushion 22 is preferably shown in a restraint system 20 mounted on the steering wheel 17, it will be appreciated that the cushion 22 could also be used in restraint systems located in other vehicle locations.

As best shown in Figure 2F, the forward wall 23 of the cushion 22 includes a cushion opening 30 for receiving discharging gas from an inflator (not shown) of the restraint system 20 to inflate the cushion 22. The inflator is preferably mounted on the steering wheel 17 and discharges gas upon sensing certain predetermined vehicle conditions to inflate the cushion 22. Preferably, the cushion opening 30 on the forward wall 23 is generally centered on the forward wall 23 of the cushion 22 as best shown in Figure 2F. The cushion opening 30 is preferably secured to the restraint system 20 in a conventional manner, such as by fasteners (not shown) extending through spaced apart fastener

apertures 32 located around the cushion opening 30, as described further hereinafter.

Figure 1 shows the cushion 22 in the fully inflated condition. However, it will be appreciated that the cushion 22 is normally stored in a folded condition within the restraint system 20. The cushion 22 may be made of any suitable material for cushion construction including a conventional heavy silicone-coated fabric material, for example having a denier of about 420 and about 46 ends per inch and about 46 picks per inch and a weight of about 6.3 ounces per square yard. However, the cushion 22 is preferably made of a lighter fabric material having a denier of about 70 and having about 200 ends per inch and about 130 picks per inch with a fabric weight of about 3.7 ounces per square yard, as enabled by the unique shape and construction of the cushion 22, described in detail hereinafter. Advantageously, the cushion 22 made of the lighter fabric material is lightweight and folds into a smaller compact package than prior art cushions.

Referring to Figure 2A, the cushion 22 is formed from a flat, single, longitudinally elongated strip 33 of suitable cushion material. Preferably the strip 33 is one-piece and continuous. The strip 33 is generally rectangular and includes a first lateral edge 40 and an opposing parallel second lateral edge 41. The strip 33 further includes a first longitudinal edge 42 and a spaced apart parallel second longitudinal edge 43. Preferably, the lateral edges 40, 41 are each about 29 inches long and the longitudinal edges 42, 43 are each about 48 inches long. However, it will be appreciated that many size variations are possible as long as the strip 33 is longitudinally elongated with longitudinal edges 42, 43 being longer than lateral edges 40, 41. The first and second longitudinal edges 42, 43 each extend between the lateral edges 40, 41 and are preferably perpendicular thereto. The strip 33 has an inner surface 34 which will provide the inside of the cushion 22 and an outer surface 35 which will

provide the outside of the cushion 22. Each of the lateral edges 40, 41 includes a generally semicircular indentation 39. The indentations 39 cooperatively form the cushion opening 30 when the lateral edges 40, 41 are joined together, as described further hereinafter. Advantageously, the 5 cushion 22 saves material in manufacturing since the entire cushion 22 is formed from a single rectangular strip 33 which enables efficient utilization of material as compared to round or other odd-shaped cushions of the prior art formed from one or more panels of material.

The entire rectangular-shaped cushion 22 is preferably 10 constructed from the single strip 33 in the following manner with reference to Figures 2A - 2F. First, the strip 33 is folded in half onto itself as shown in Figure 2B with the inner surface 34 facing outward. At this stage, the forward and rearward walls 23, 24 are not directly opposing each other. In this folded condition, the first and second lateral edges 40, 15 41 are matingly aligned atop each other and the indentations 39 are also generally aligned with each other. In addition, the first longitudinal edge 42 is folded over onto itself to provide first longitudinal mating edges 45 and the second longitudinal edge 43 is folded over onto itself to provide second longitudinal mating edges 46.

Next the mating first and second lateral edges 40, 41 are 20 connected to each other, preferably by sewing, to form a lateral seam 48 including a corresponding edge margin 49. Forming the lateral seam 48 is easily accomplished since the lateral seam 48 is located on an accessible outer perimeter of the strip 33 when sewn. The lateral seam 48 is 25 preferably discontinuous about the cushion opening 30 which is cooperatively defined by the indentations 39. The lateral seam 48 forms the strip 33 into a continuous loop as shown in Figures 2B - 2D.

Referring to Figures 2B and 2C, the strip 33 formed into the loop is turned or adjusted to position the forward wall 23 such that it is 30 directly opposing the rearward wall 24 and such that two folded side edges

25 of the cushion 22 are formed between the forward and rearward walls 23, 24. Simultaneously, the location of the lateral seam 48 is preferably adjusted generally onto the center of the forward wall 23. Also, the 5 location of the cushion opening 30 is preferably simultaneously adjusted by generally centering the cushion opening 30 on the forward wall 23 of the cushion 22. While the cushion opening 30 and lateral seam 48 are shown as preferably centered on the forward wall 23, it will be appreciated that the cushion opening 30 and lateral seam 48 may be adjusted to any desired position on the forward wall 23 of the cushion 22 by turning the strip 33.

10 Referring to Figure 2C, the next step is to preferably provide a reinforcement patch 55 sized to fit around the cushion opening 30 for strengthening the area around the cushion opening 30 for attachment to the restraint system 20. The reinforcement patch 55 may also preferably be made of a heat resistant material for shielding the cushion 22 15 from heat generated by the inflator when discharging inflator gas. Preferably, the reinforcement patch 55 is connected to the cushion 22 by sewing inner and outer seams 56 and 57, respectively. Referring to Figure 2D, the reinforcement patch 55 and adjacent cushion 22 are provided with fastener apertures 32 spaced apart around the cushion opening 30 for 20 receiving fasteners (not shown) therethrough for attachment of the cushion 22 to the restraint system 20. It will be appreciated that more than one reinforcement patch 55 or heat shield may be provided or that none may be provided. Although the cushion 22 is shown as being attached to the restraint system 20 by a plurality of fasteners, it will further be appreciated 25 that other methods may also be used to attach the cushion 22 to the restraint system 20.

The next step in making the cushion 22 is shown with reference to Figure 2E. With the forward and rearward walls 23, 24 in position directly opposing each other, the first longitudinal mating edges 30 45 formed by the first longitudinal edge 42 are connected to each other

such as by sewing to form a first longitudinal seam 50 having a corresponding edge margin 51. Also, the second longitudinal mating edges 46 formed by the second longitudinal edge 43 are connected to each other such as by sewing to form a second longitudinal seam 52 having a 5 corresponding edge margin 53. It will be appreciated that the first and second longitudinal seams 50, 52 provide two more of the side edges 25 of the cushion 22. It will also be appreciated that the first and second longitudinal seams 50, 52 are easily sewn since they are located on an outer perimeter of the strip 33. Thus, it will be appreciated that the 10 cushion 22 is easily assembled since all of the seams 48, 50, 52 are located on an outer perimeter of the strip 33 when they are sewn together. Also advantageously, the seams 48, 50, 52 are all simple straight edges also enabling easy assembly. While the seams 48, 50, 52 are preferably connected by sewing, other methods of connection may also be used such 15 as bonding or weaving.

The final step is shown with reference to Figures 2E and 2F. The cushion 22 is fully sewn as shown in Figure 2E with the inner surface 34 facing outward. However, it is preferred that the edge margins 49, 51, 53 of the seams 48, 50, 52 and the reinforcement patch 55 be 20 positioned inside the cushion 22 such that a smooth outer surface 35 is presented to the occupant 14. Thus, the entire cushion 22 is turned inside out through the cushion opening 30 such that the outer surface 35 of the cushion 22 is facing outward to complete construction of the cushion 22. Also, the reinforcement patch 55 and edge margins 49, 51, 53 are located 25 inside the cushion 22 such that a neat and smooth outer surface 35 is presented to the occupant 14. In the final assembled condition, the cushion 22 has directly opposing forward and rearward walls 23, 24 with four side edges 25 joining the forward and rearward walls 23, 24. Preferably, the lateral seam 48 is located on the forward wall 23 and the longitudinal 30 seams 50, 52 are located on any two of the four side edges 25 of the

cushion 22. It will further be appreciated that the lateral seam 48 may alternately be located on another of the side edges 25 of the cushion 22, but preferably is not located on the rearward wall 24 of the cushion 22 which faces the occupant 14.

5 After completion of the cushion 22, the cushion 22 is suitably attached to the restraint system 20, such as by the use of fasteners through fastener apertures 32. Upon sensing predetermined vehicle conditions, the inflator generates gas which is received through the cushion opening 30 and the cushion 22 is inflated as shown in Figure 1. It will be
10 appreciated that the cushion 22 presents a smooth rearward wall 24 to the occupant 14 since the lateral seam 48 is positioned on the forward wall 23 and the longitudinal seams 50, 52 are positioned on side edges 25 of the cushion 22 between the forward and rearward walls 23, 24.

Advantageously, the generally rectangular-shaped cushion
15 22 produces lower stresses on the cushion 22 during inflation than typical round cushions of the prior art. Also advantageously, the positioning of the seams 48, 50, 52 produces lower stresses on the seams 48, 50, 52 during cushion inflation than typical round cushions of the prior art, thus enabling lighter materials to be used to make the cushion 22. When lighter
20 materials are used, the cushion 22 may be more lightweight and folded to a more compact shape than round cushions of the prior art. While the present cushion 22 is preferably formed with fabric material, the cushion 22 may also be constructed of any other flexible material having a low porosity for retaining inflator gas.

25 It will be appreciated that the generally rectangular cushion 22 is easy to construct since all of the seams 48, 50, 52 are positioned on outer edges of the strip 33 for easy accessibility when sewing and also present simple straight edges. It will be appreciated that the cushion 22 is also extremely easy to assemble and handle since only one elongated strip
30 33 of material is needed to form the entire cushion 22.

It will be understood that a person skilled in the art may make modifications to the preferred embodiment shown herein within the scope and intent of the claims. For example, Figures 3A-3D show an alternate embodiment of the cushion 22' with similar features denoted by similar numerals. Referring to Figure 3A, a cushion 22' is formed from a flat, single longitudinally elongated rectangular strip 33' of suitable cushion material. Preferably the strip 33' is one-piece and continuous. The strip 33' includes a first lateral edge 40', an opposing second lateral edge 41', and first and second longitudinal edges 42', 43' extending between the lateral edges 40', 41'. The strip 33' has an inner surface 34' and an opposite outer surface 35'. The strip 33' includes a cushion opening 30' positioned proximate the first lateral edge 40' such that the cushion opening 30' is properly positioned for attachment to a restraint system 20.

The entire rectangular-shaped cushion 22' is preferably constructed from the single strip 33' in the following manner with reference to Figures 3A - 3D. Preferably, the first step is to provide a reinforcement patch 55' sized to fit around the cushion opening 30' for strengthening the area around the cushion opening 30' for attachment to the restraint system 20. The reinforcement patch 55' may also preferably be made of a heat resistant material. Preferably, the reinforcement patch 55' is connected to the inner surface 34' of the strip 33' by sewing inner and outer seams 56' and 57', respectively. Advantageously, this arrangement permits any desired reinforcement patches 55' to be sewn onto the strip 33' while it is still in a flat condition and not in a looped condition as shown in the embodiment in Figures 2A-2E. Referring to Figure 3B, the reinforcement patch 55' and adjacent cushion 22' are provided with the fastener apertures 32' spaced apart around the cushion opening 30' for receiving fasteners (not shown) therethrough to attach the cushion 22' to the restraint system 20.

Next, the strip 33' is folded in half onto itself such that the first and second lateral edges 40', 41' are matingly aligned atop each other and are accessibly located on an outer perimeter of the strip 33' with the inner surface 34' facing outward, with reference to Figure 3C and similar to the view shown in Figure 2B. In addition, the first longitudinal edge 42' is folded over onto itself to provide first longitudinal mating edges 45' and the second longitudinal edge 43' is folded over onto itself to provide second longitudinal mating edges 46'. In the described condition, the mating first and second lateral edges 40' 41' are connected to each other, preferably by sewing, to form a lateral seam 48' including an edge margin 49' as best shown in Figure 3C. Forming the lateral seam 48' is easily accomplished since the lateral seam 48' is located on an accessible outer perimeter of the strip 33' when sewn. The lateral seam 48' now forms the strip 33' into a continuous loop as shown in Figure 3C. Since the reinforcement patch 55' is attached prior to making the strip 33' into a loop, advantageously the sewing machine need not access within the loop and sewing operations are more accessible and easier.

Referring to Figure 3C, the strip 33' forming the loop is adjusted to position a forward wall 23' and a rearward wall 24' directly opposing each other and forming two folded side edges 25' of the cushion 22'. Simultaneously, the location of the lateral seam 48' is also adjusted onto the forward wall 23'. Also, the location of the cushion opening 30' is preferably simultaneously adjusted by generally centering the cushion opening 30' on the forward wall 23' of the cushion 22'. It will be appreciated that the lateral seam 48' may also be located on one of the side edges 25' of the cushion 22' when the forward and rearward walls 23', 24' are directly opposing each other, dependent on the desired location and size of the cushion opening 30' and reinforcement patch 55'.

The next step in making the cushion 22' is shown with reference to Figure 3D. With the forward and rearward walls 23', 24' in

position, the first longitudinal mating edges 45' formed by the first longitudinal edge 42' are connected to each other such as by sewing to form a first longitudinal seam 50' having a corresponding edge margin 51'. Also, the second longitudinal mating edges 46' formed by the second longitudinal edge 43' are connected to each other such as by sewing to form a second longitudinal seam 52' having a corresponding edge margin 53'. The first and second longitudinal seams 50', 52' are located on the other two side edges 25' of the cushion 22'. It will be appreciated that the first and second longitudinal seams 50', 52' are easily formed since they are located on an outer perimeter of the strip 33' forming the cushion 22'. Thus, it will be appreciated that the cushion 22' is easily assembled since all of the seams 48', 50', 52' are easily accessible and generally straight.

The final step is similar to that shown in Figure 2F of the first embodiment. The cushion 22' is fully sewn as shown in Figure 3D with the inner surface 34' facing outward. Finally, the entire cushion 22' is turned inside out through the cushion opening 30' such that the outer surface 35' of the cushion 22' is facing outward to complete construction of the cushion 22'. Thus, the edge margins 49', 51', 53' and the reinforcement patch 55' are located inside the cushion 22' such that a smooth outer surface 35' is presented to the occupant 14. In the assembled condition, the cushion 22' has directly opposing forward and rearward walls 23', 24' with side edges 25' joining the forward and rearward walls 23', 24'. Preferably, the lateral seam 48' is located on the forward wall 23' and the longitudinal seams 50', 52' are located on any two of the four side edges 25' of the cushion 22'. It will further be appreciated that the lateral seam 48' may alternately be located on another of the side edges 25' of the cushion 22', but preferably is not located on the rearward surface 24' of the cushion 22' which faces the occupant 14.

After completion of the cushion 22', the cushion is suitably attached to the restraint system 20, such as by the use of fasteners through

fastener apertures 32'. Upon sensing predetermined vehicle conditions, the inflator generates gas which is received through the cushion opening 30' and the cushion 22' is inflated as shown in Figure 1. It will be appreciated that the cushion 22' presents a smooth rearward wall 24' to the occupant 14 since the lateral seam 48' is positioned on the forward wall 23'.

Advantageously, the generally rectangular-shaped cushion 22' having a lateral seam 48' on the forward wall 23' and first and second longitudinal seams 50', 52' joining the forward and rearward walls 23', 24' produces lower stresses on the seams 48', 50', 52' during inflation than typical round cushions of the prior art. Thus, lighter materials may be used such that the cushion 22' may be folded to a more compact shape for packaging.

1. An inflatable restraint cushion (22) comprising:
a single longitudinally elongated strip (33) of material
folded onto itself and having overlying outer mating edges (40, 41, 42, 43)
connected together to provide a generally rectangular-shaped cushion (22).
2. The restraint cushion (22) of claim 1 wherein the strip
(33) is one continuous piece of material.
3. The restraint cushion (22) of claim 1 wherein the strip
(33) is generally rectangular.
4. The restraint cushion (22) of claim 1 wherein the strip
(33) is generally rectangular with first and second spaced apart parallel
lateral edges (40, 41) and first and second spaced apart parallel
longitudinal edges (42, 43) and wherein the longitudinal edges (42, 43)
5 have a length greater than a length of the lateral edges (40, 41) and
wherein the first and second lateral edges (40, 41) overlie each other and
are connected to each other to provide a lateral seam (48) and wherein the
first longitudinal edge (42) overlies itself and is connected to itself to
provide a first longitudinal seam (50) and wherein the second longitudinal
edge (43) overlies itself and is connected to itself to provide a second
10 longitudinal seam (52).
5. The restraint cushion (22) of claim 1 wherein the
cushion (22) includes a forward face (23) and an opposing rearward face
(24) and four side edges (25) interconnecting the forward and rearward
faces (23, 24) and wherein the cushion includes first and second
5 longitudinal seams (42, 43) located on two of the side edges (25) and
wherein the cushion includes a lateral seam (48) located on the forward
face (23).

6. The restraint cushion (22) of claim 1 wherein the cushion (22) includes a forward face (23) and an opposing rearward face (24) and four side edges (25) interconnecting the forward and rearward faces (23, 24) and wherein the cushion (22) includes first and second longitudinal seams (42, 43) located on two of the side edges (25) and wherein the cushion (22) includes a lateral seam (48) located on another of the side edges (25).

7. The restraint cushion (22') of claim 1 wherein the strip (33') is generally rectangular with first and second lateral edges (40', 41') and first and second longitudinal edges (42', 43') and wherein the strip (33') includes a cushion opening (30') thereon which is spaced apart from the lateral and longitudinal edges (40', 41', 42', 43').

8. The restraint cushion (22) of claim 1 wherein the strip (33) has opposing lateral edges (40, 41) each including an indentation (39) thereon and wherein the lateral edges (40, 41) are connected to each other such that the indentations (39) cooperatively define a cushion opening (30).

9. The restraint cushion (22') of claim 1 wherein the strip (33') is rectangular and wherein there are exactly three continuous and straight seams (48', 50', 52') on the cushion (22').

10. A method of making a generally rectangular restraint cushion (22) comprising the steps of:

a. providing a single longitudinally elongated strip of material (33);

- 5 b. folding the material in half to provide a folded lateral edge, mating lateral edges (40, 41) overlying each other, and first and second mating longitudinal edges (42, 43) overlying each other;
- c. connecting the mating lateral edges (40, 41) to form the strip (33) into a continuous loop having a lateral seam (48); and
- 10 d. connecting the respective overlying longitudinal edges (42, 43) together to provide first and second longitudinal seams (50, 52).

11. The method of claim 10 further comprising the steps of:

5 providing a single cushion opening (30') in the strip (33') the cushion opening being spaced apart from the lateral and longitudinal edges (40', 41', 42', 43'); and

 turning the cushion (22') inside out through the cushion opening (30') such that edge margins of the lateral seam (48') and first and second longitudinal seams (50', 52') are positioned inside the cushion (22').

12. The method of claim 10 further comprising the steps of:

5 providing a cushion opening (30') in the strip (33'), the cushion opening being spaced apart from the lateral and longitudinal edges (40', 41', 42', 43'); and

 turning the loop to provide a forward face (23') having the cushion opening (30') thereon and a rearward face (24') directly opposing the forward face (23') prior to connecting the respective longitudinal edges (42', 43').

13. The method of claims 11 or 12 further comprising the steps of connecting a reinforcement (55') around the cushion opening (30').

14. The method of claim 10 further comprising the steps of providing a cushion opening (30) on the strip (33) and adding a reinforcement (55) around the cushion opening (30) prior to connecting the respective longitudinal edges (42, 43).

15. The method of claim 10 further comprising the steps of providing a cushion opening (30) on the strip (33) and adding a reinforcement (55) around the cushion opening (30) prior to connecting the mating lateral edges (40, 41) and prior to connecting the longitudinal edges
5 (42, 43).

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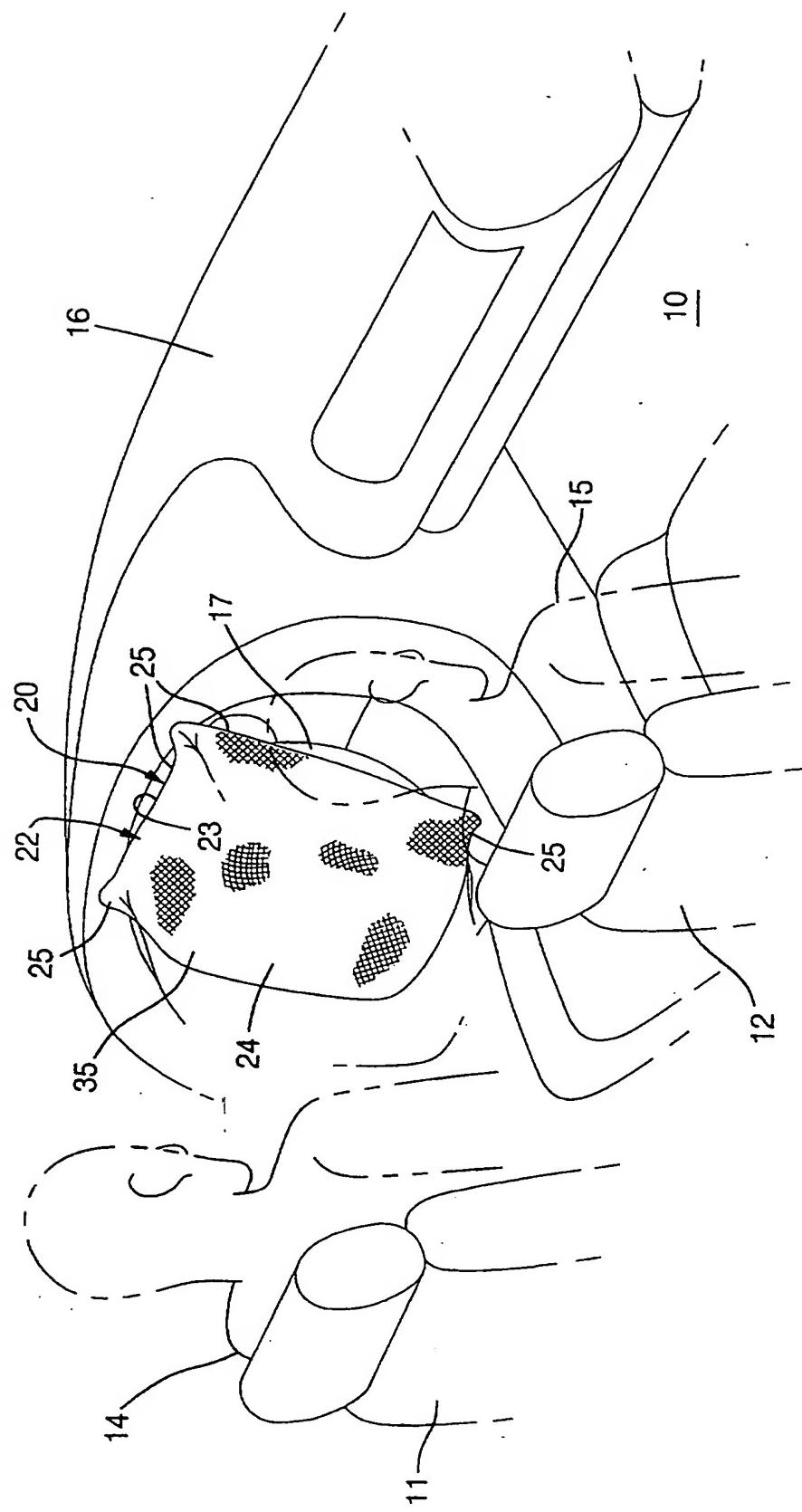


FIG. 1

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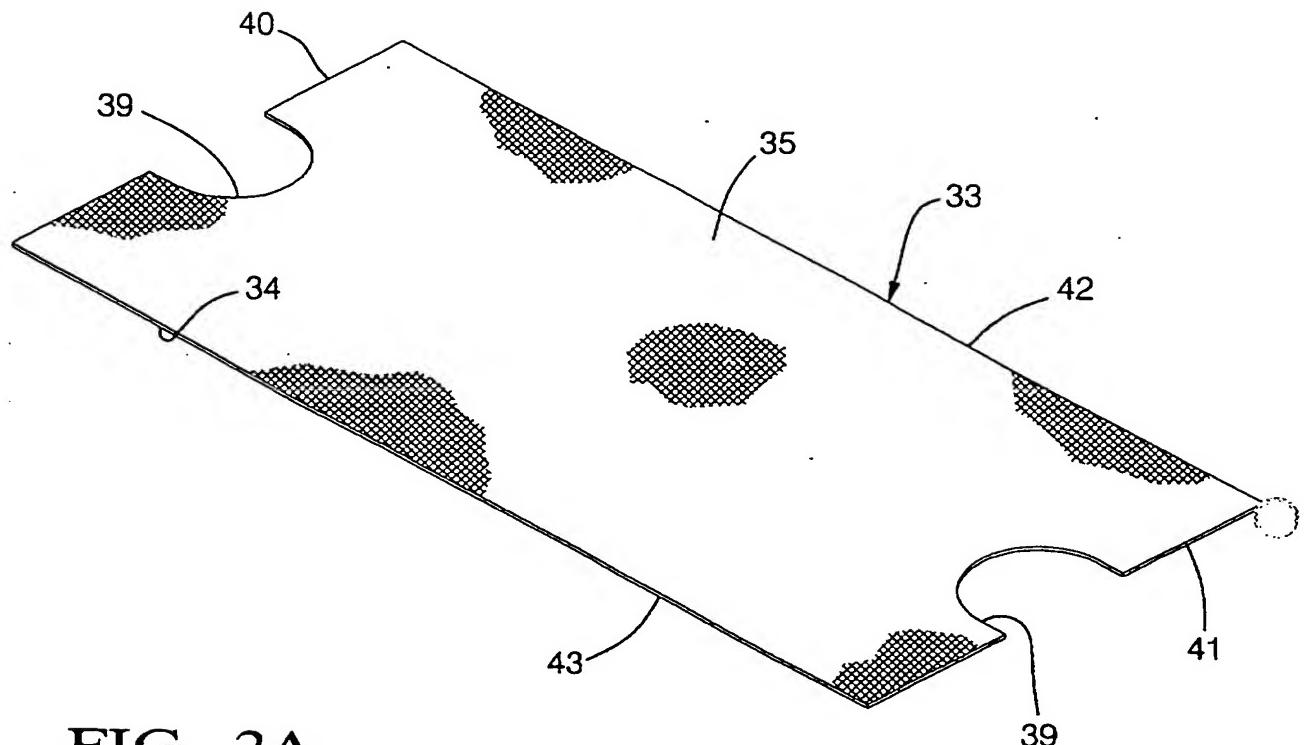


FIG. 2A

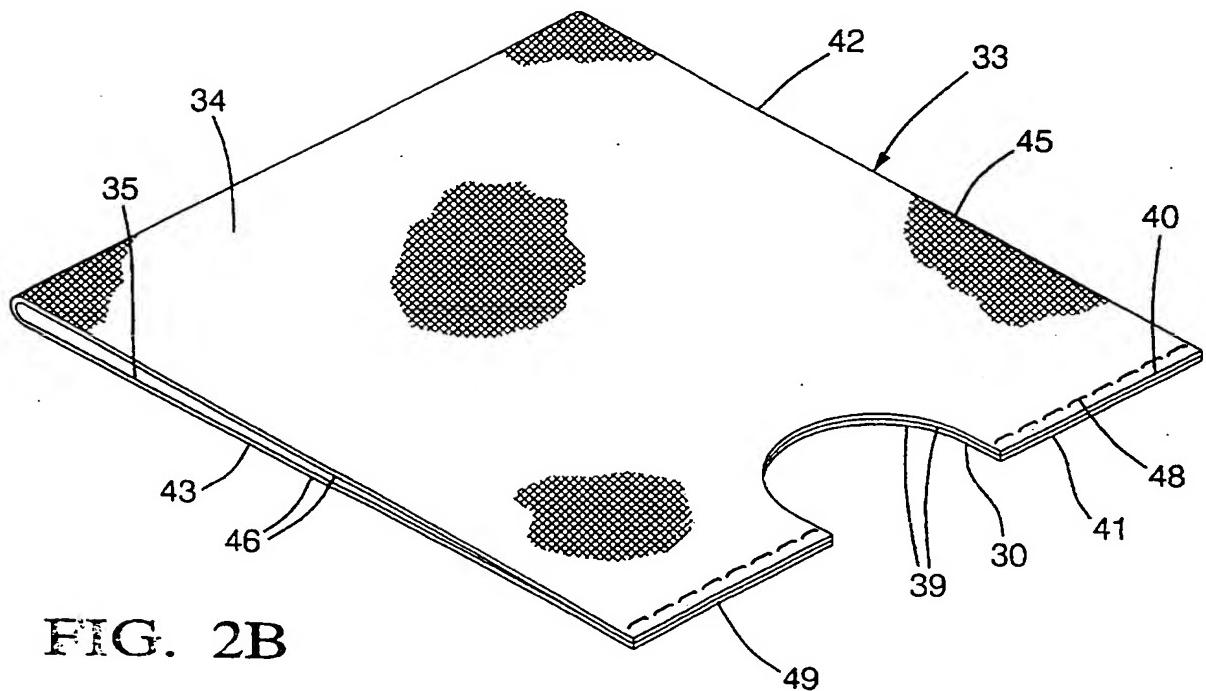


FIG. 2B

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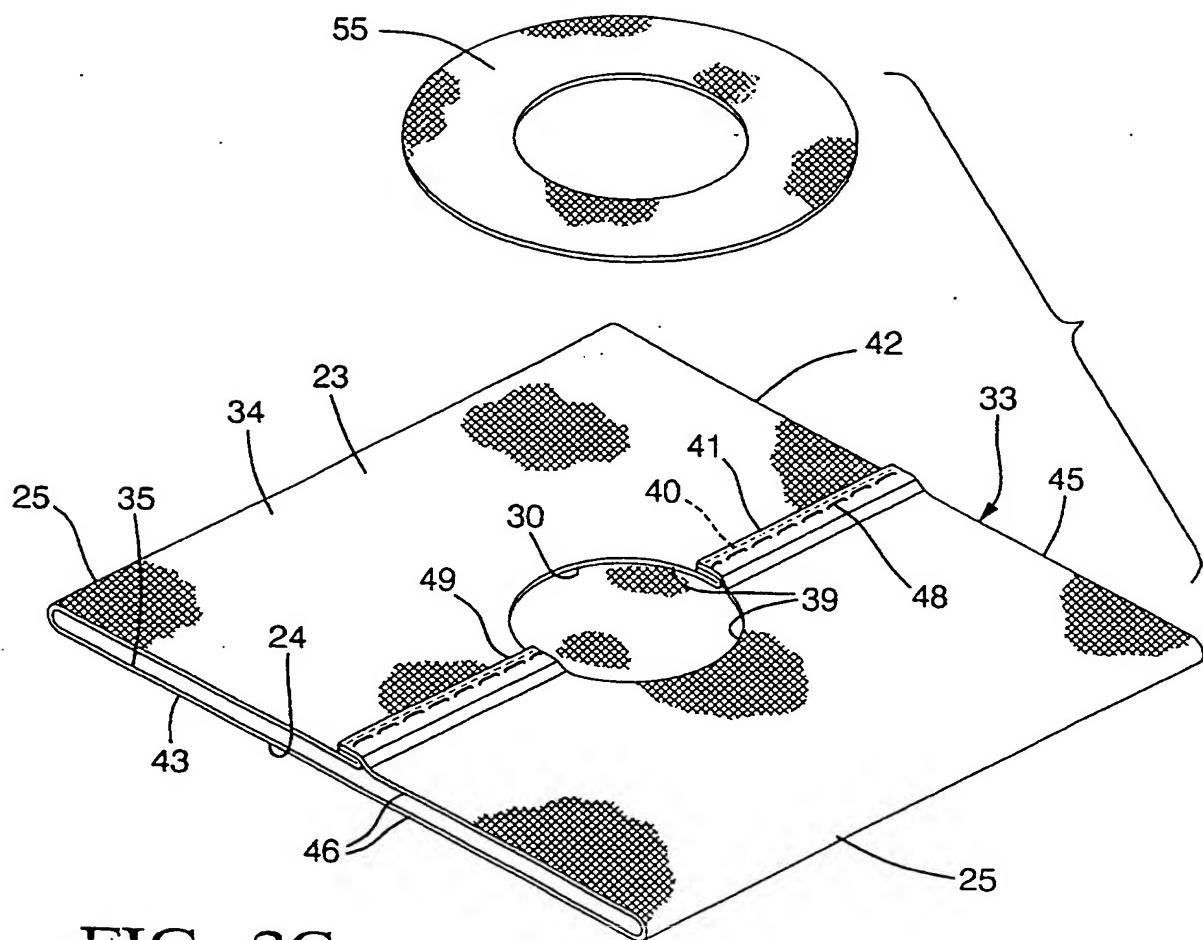


FIG. 2C

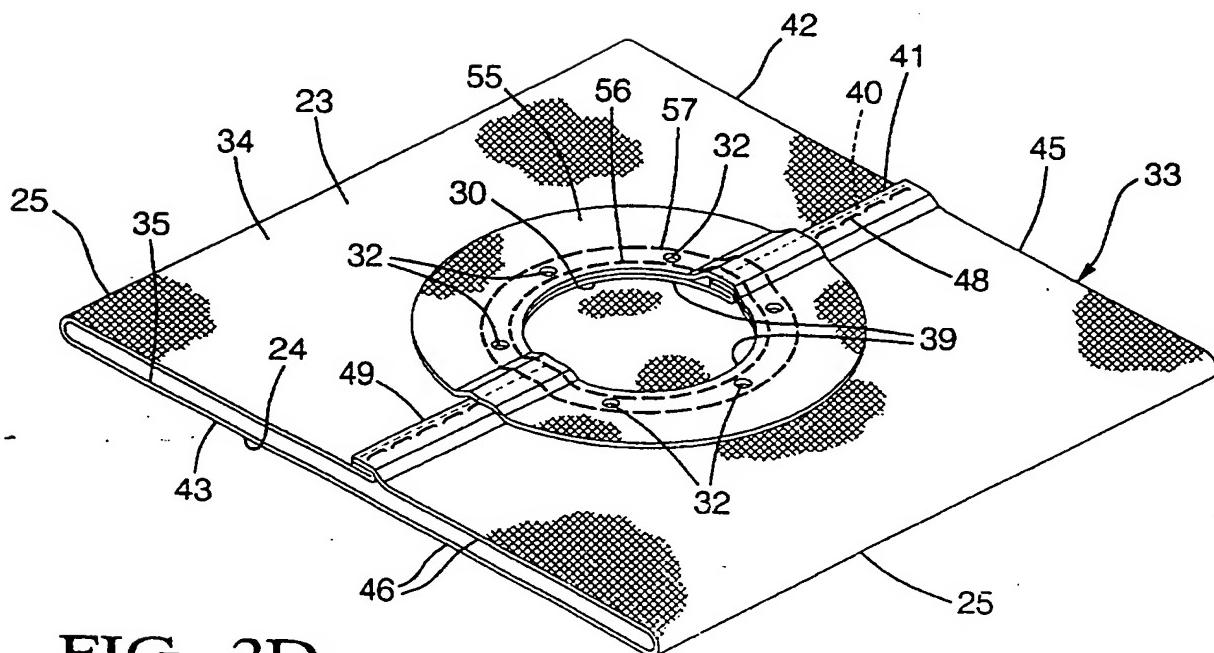


FIG. 2D

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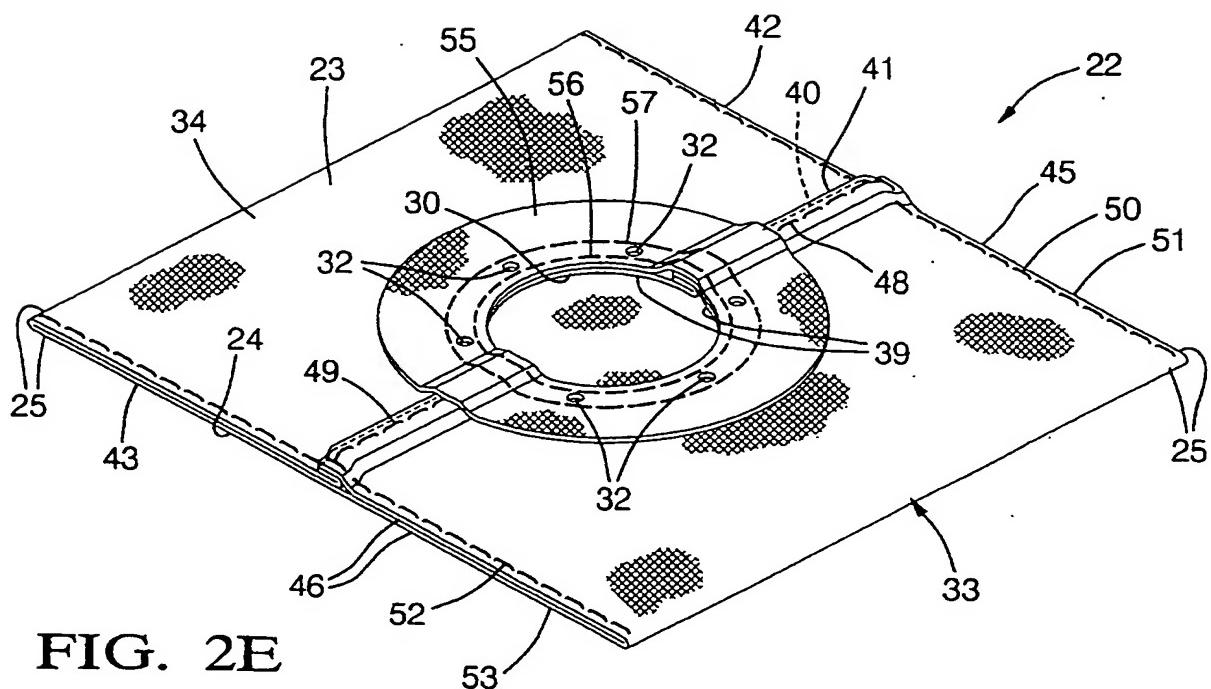


FIG. 2E

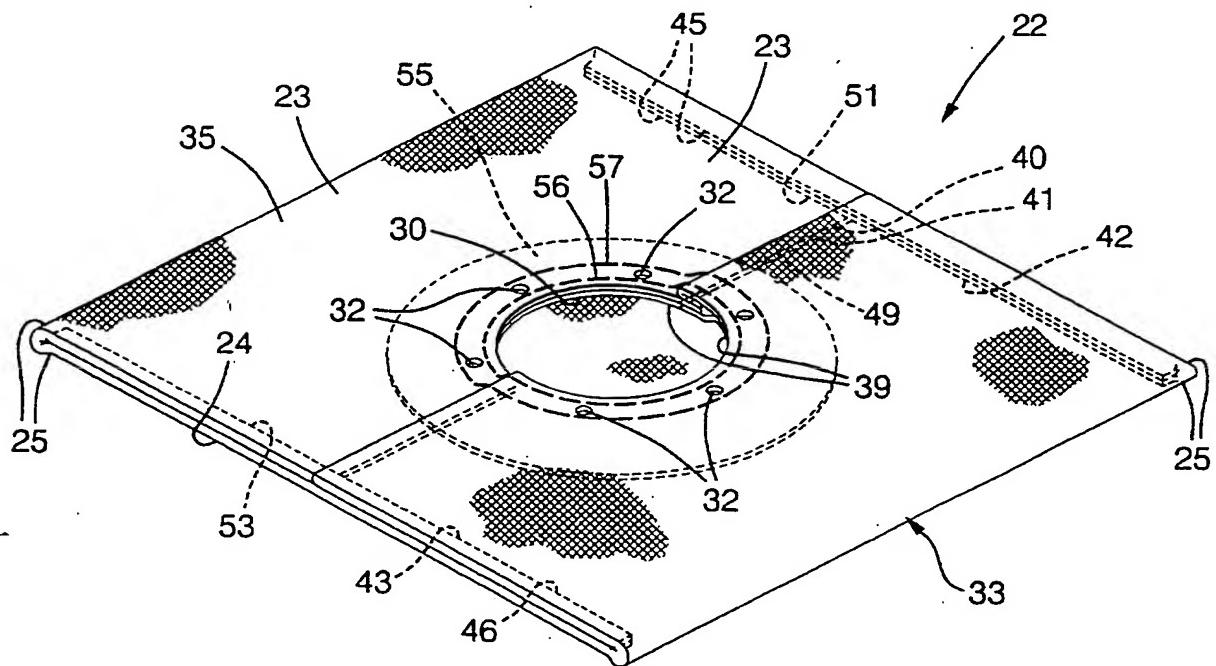


FIG. 2F

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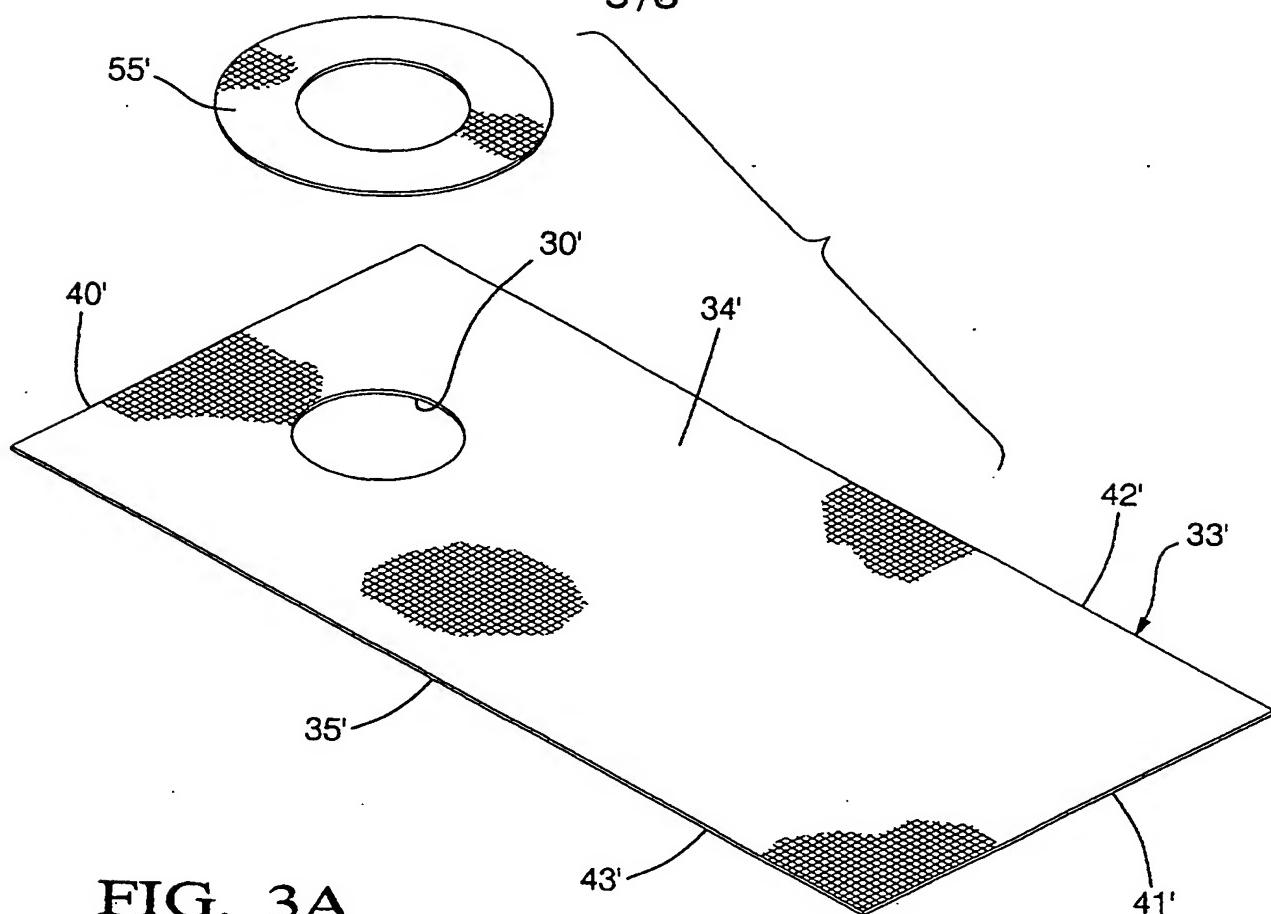


FIG. 3A

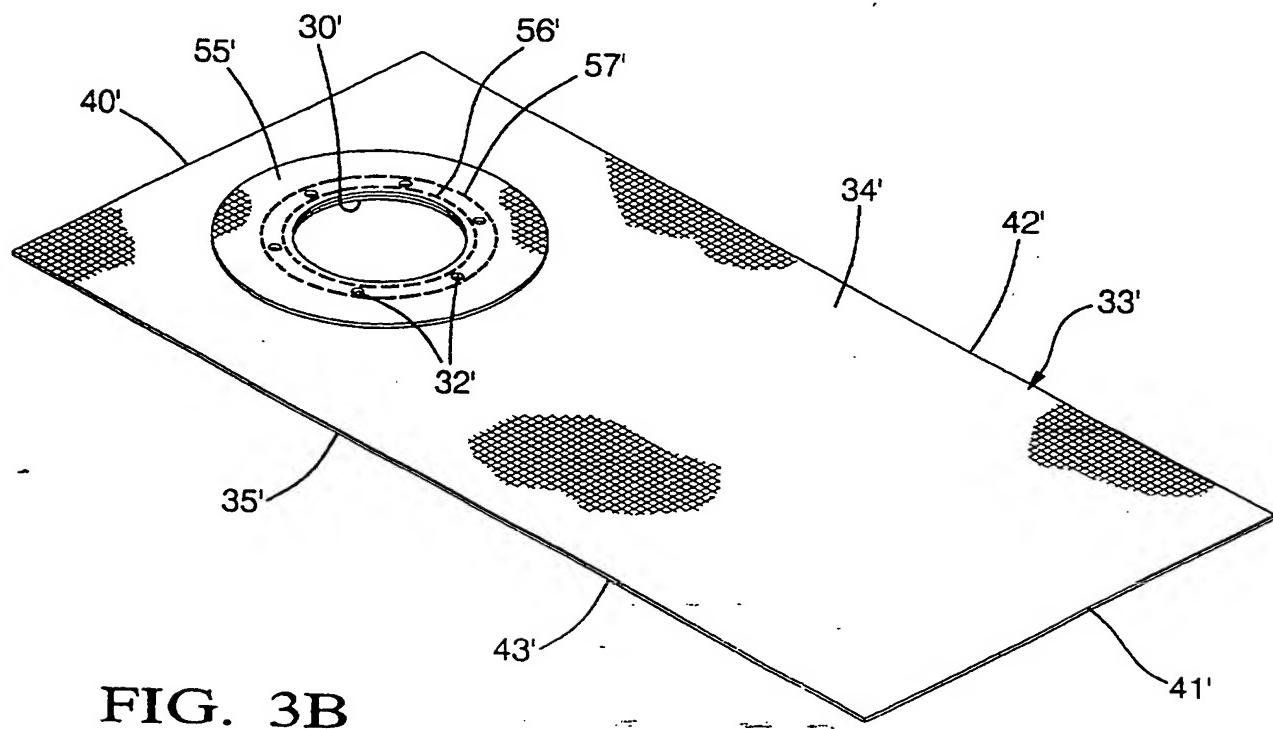


FIG. 3B

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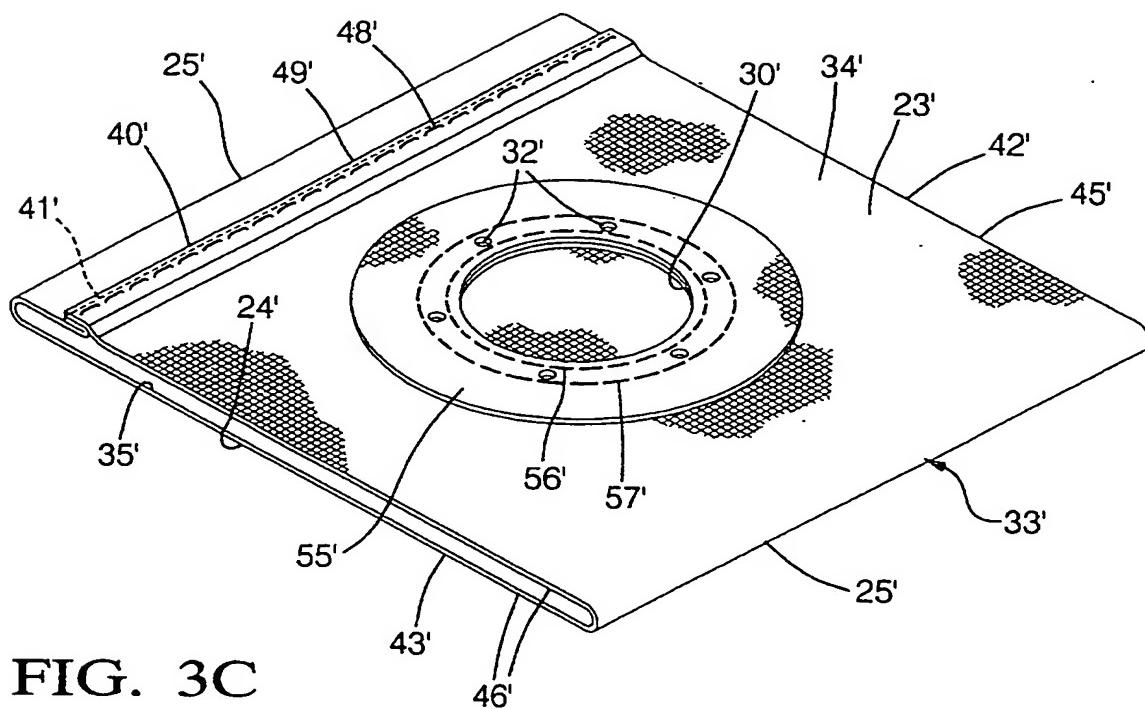


FIG. 3C

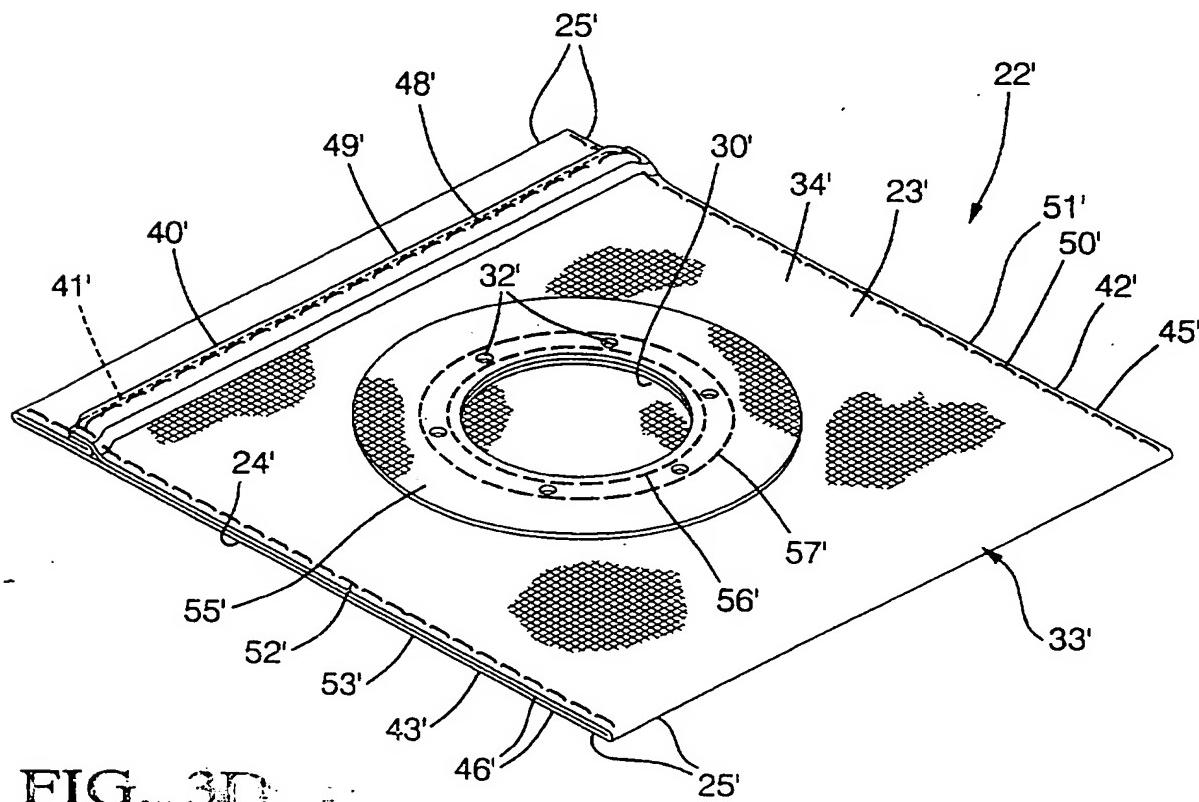


FIG. 3D

INTERNATIONAL SEARCH REPORT

Intern'l Application No
PCT/US 97/04753

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B60R21/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 195 12 436 A (NIPPONDENSO CO., LTD.) 5 October 1995 see column 4, line 8 - line 20; figures 3,4 see column 6, line 15 - line 52; figures 5,6	1-4,6,7, 9,10
Y	---	11,13-15
Y	EP 0 679 555 A (TOYOTA GOSEI CO., LTD.) 2 November 1995 see column 4, line 47 - column 5, line 10; figures 2,3 ---	11,13-15
	-/-	

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

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1

Date of the actual completion of the international search	Date of mailing of the international search report
8 July 1997	21.07.97
Name and mailing address of the ISA European Patent Office, P.B. 5218 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl. Fax (+ 31-70) 340-3016	Authorized officer Dubois, B

INTERNATIONAL SEARCH REPORT

Internat'l Application No
PCT/US 97/04753

C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 41 25 530 A (TRW VEHICLE SAFETY SYSTEMS INC.) 6 February 1992 see column 5, line 6 - line 55; figures 3-9 see column 6, line 3 - line 6	1-5,7,9
A	---	10
X	WO 95 00366 A (SANDIA CORP.) 5 January 1995 see page 6, line 21 - page 7, line 6; figures 2,3 see page 7, line 24 - line 30 see page 9, line 29 - page 10, line 6; figure 12	1-3,6, 8-10
A	---	4
X	US 5 310 216 A (WEHNER ET AL.) 10 May 1994 see column 2, line 6 - line 17; figures 1-8 see column 2, line 58 - column 3, line 43	1,2,5,10
A	-----	3,4,8, 11,12

INTERNATIONAL SEARCH REPORT

Internal Application No

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EP 679555 A	02-11-95	JP 7291068 A US 5542698 A	07-11-95 06-08-96
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